

## **DIVISION VIII**

## **GALAXIES AND THE UNIVERSE**

### *LES GALAXIES ET L'UNIVERS*

Division VIII brings together astronomers studying a wide range of problems related to galaxies and cosmology. The objects studied include individual galaxies, groups and clusters of galaxies, large scale structure, cosmic background radiation and the universe itself. The approaches and techniques used are also diverse, based around observational data (including large, multi-wavelength data sets), theoretical studies and computer simulations and modelling.

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### **TRIENNIAL REPORT 2009-2012**

#### **1. Introduction**

The fields of extragalactic research and cosmology have continued to progress rapidly over the past three years, as detailed in the reports of the Commission Presidents, and we are pleased to acknowledge the award of the 2011 Nobel Prize in Physics to Saul Perlmutter, Brian P. Schmidt and Adam G. Riess for “the discovery of the accelerating expansion of the Universe through observations of distant supernovae”. The Gruber Cosmology Prize was awarded in 2009 to Wendy L. Freedman, Robert C. Kennicutt and Jeremy Mould for their leadership of the Hubble Space Telescope Key Project on the Extragalactic Distance Scale, in 2010 to Charles Steidel for the identification and study of galaxies in the very distant universe, and in 2011 to Marc Davis, George Efstathiou, Carlos Frenk and Simon D.M. White for pioneering the use of numerical simulations as a tool to model and interpret the large-scale distribution of galaxies and dark matter.

#### **2. Observations**

On the observational side, progress over the past three years has continued to be driven by a range of multi-wavelength surveys of the local and distant Universe. Some highlights from 2009-12 include the release of the first data from the *Fermi* gamma-ray space telescope (launched in 2008), the successful launch of the NASA WISE (mid-IR) and ESA Herschel (far-IR/sub-millimetre) and Planck (CMB) satellites, and the 2009

refurbishment of the Hubble Space Telescope. Data also continue to flow in from a range of large ground-based spectroscopic and imaging surveys at optical, infrared, radio and millimetre wavelengths. The need to process, store and provide rapid access to an ever-growing ‘data tsunami’ of information will be an important challenge for our discipline in the coming years.

### 3. Theory and modelling

Numerical models and simulations play an increasingly important role in the analysis and interpretation of extragalactic data, both in cosmology (e.g. through models of the growth of cosmic structure over time) and in studies of galaxy evolution (e.g. via models of AGN feedback processes and their effect on the star-formation history of galaxies). The recent rapid growth in the availability and power of high-performance computers, together with the development of increasingly sophisticated algorithms, means that the resolution and detail of hydrodynamical and semi-analytic simulations are continually improving, though the innate complexity of the baryonic physics and feedback processes involved in real galaxies remains a challenge.

### 4. Meetings

Supporting IAU meetings is a key activity for the Division, and in 2009-12 Division VIII members have been involved in the following IAU Symposia, as well as a wide range of other meetings worldwide (see the CADIC International Astronomy Meetings List at <http://www1.cadc-ccda.hia-ihp.nrc-cnrc.gc.ca/meetings/> for a comprehensive list).

- IAU Symp. 271, *Astrophysical dynamics – from stars to galaxies*, Nice, France, Jun 2010
- IAU Symp. 274, *Advances in plasma astrophysics*, Catania, Italy, Sep 2010
- IAU Symp. 275, *Jets at all scales*, Buenos Aires, Argentina, Sep 2010
- IAU Symp. 277, *Tracing the ancestry of galaxies (on the land of our ancestors)*, Ouagadougou, Burkina Faso, Dec 2010
- IAU Symp. 279, *Death of Massive Stars: Supernovae and Gamma-Ray Bursts*, Nikko, Japan, Mar 2012
- IAU Symp. 280, *The Molecular Universe*, Toledo, Spain, Jun 2011
- IAU Symp. 284, *The spectral energy distribution of galaxies (SED2011)*, Preston, UK, Sep 2011
- IAU Symp. 289, *Advancing the physics of cosmic distances*, Beijing, China, Aug 2012
- IAU Symp. 292, *Molecular Gas, Dust, and Star Formation in Galaxies*, Beijing, China, Aug 2012
- IAU Symp. 295, *The intriguing life of massive galaxies*, Beijing, China, Aug 2012

### 5. Closing Remarks

Division VIII (with 1750 members) remains the largest IAU Division, and its members continue to work on a wide range of research topics with the aim of advancing our understanding of the properties of galaxies, the formation and evolution of galaxies and large-scale structure and the physics and nature of the Universe as a whole.

Elaine M. Sadler  
*President of the Division*